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Gateway to the Earth

Battery Raw Materials

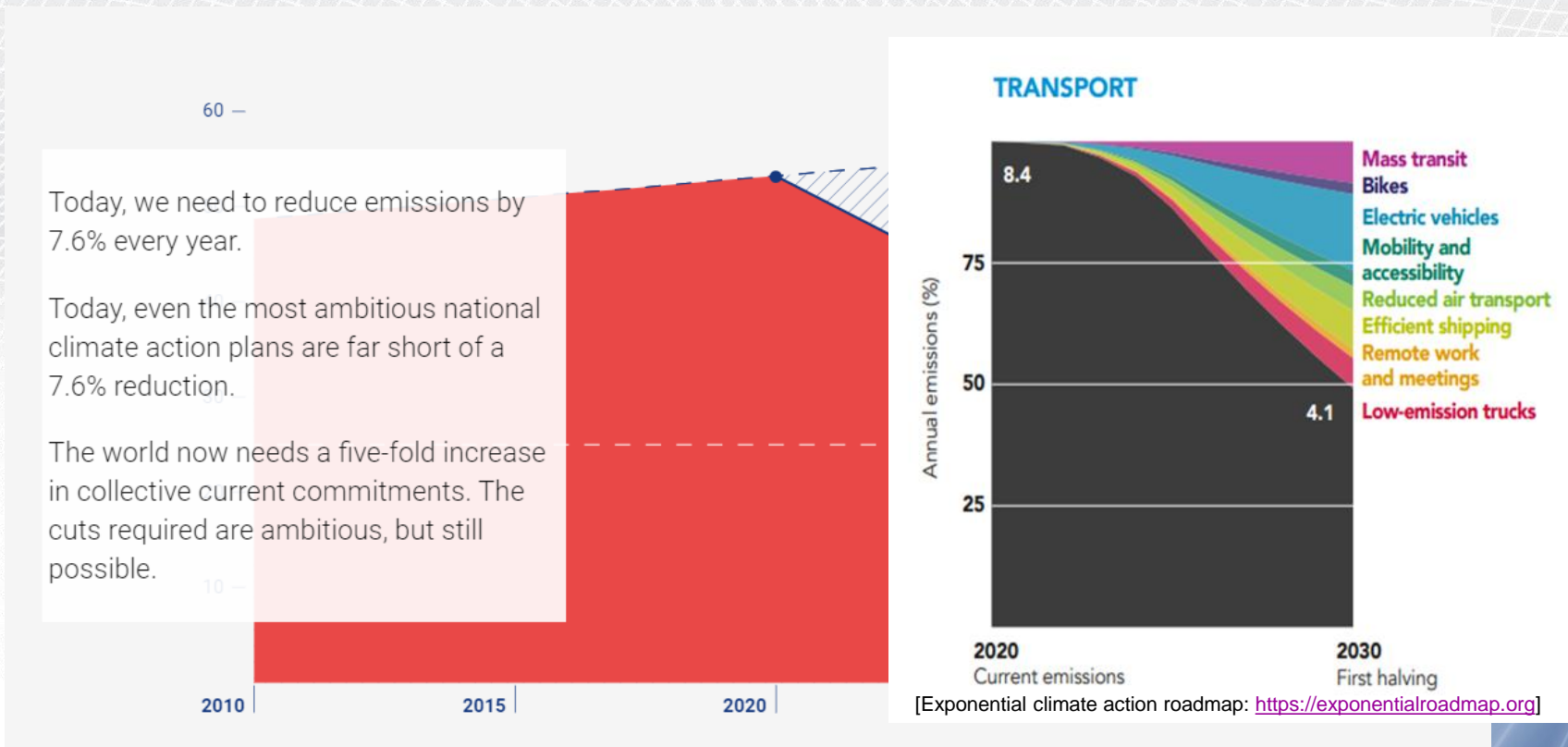
Demand and supply opportunities and implications

Dr Evi Petavratzi

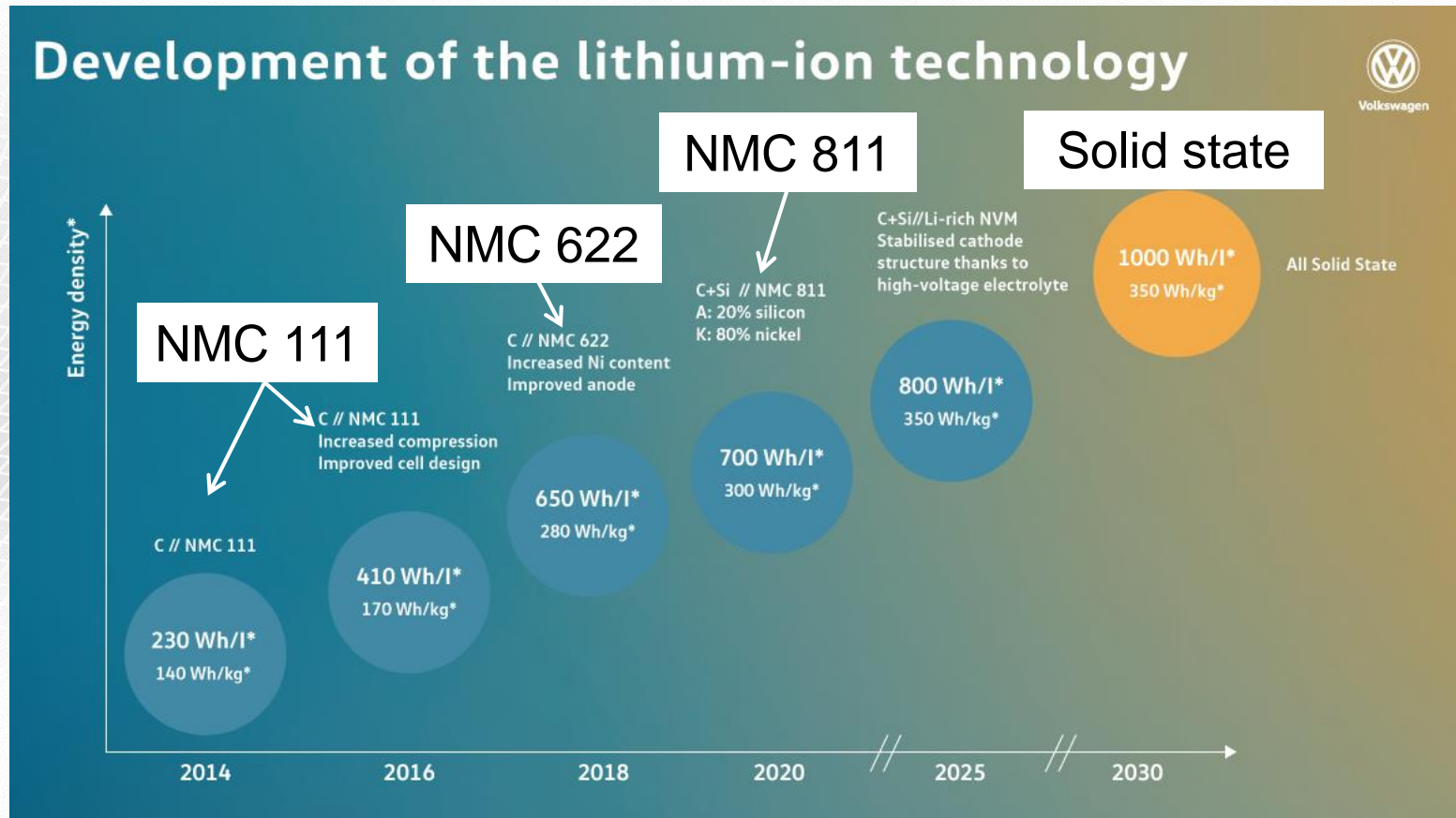
Warming Stripes
Annual global temperatures from 1850-2017

Climate change: the **BIG** challenge

Technological revolutions are not consciously decided by humanity. There is a need for them. (Yanis Varoufakis)



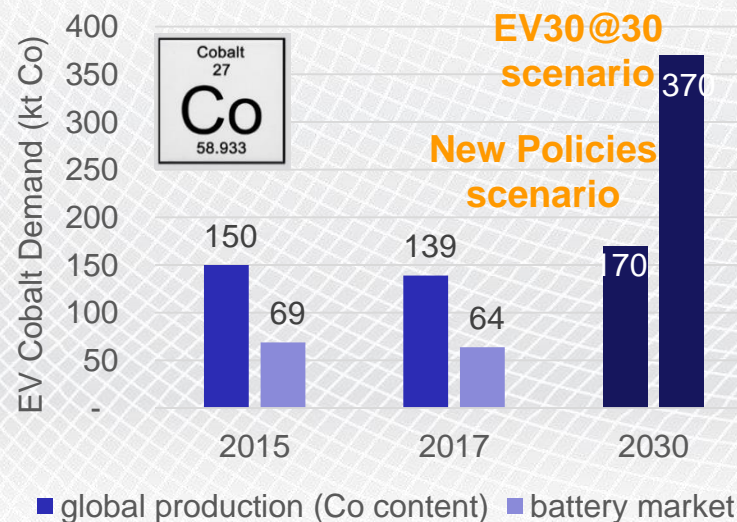
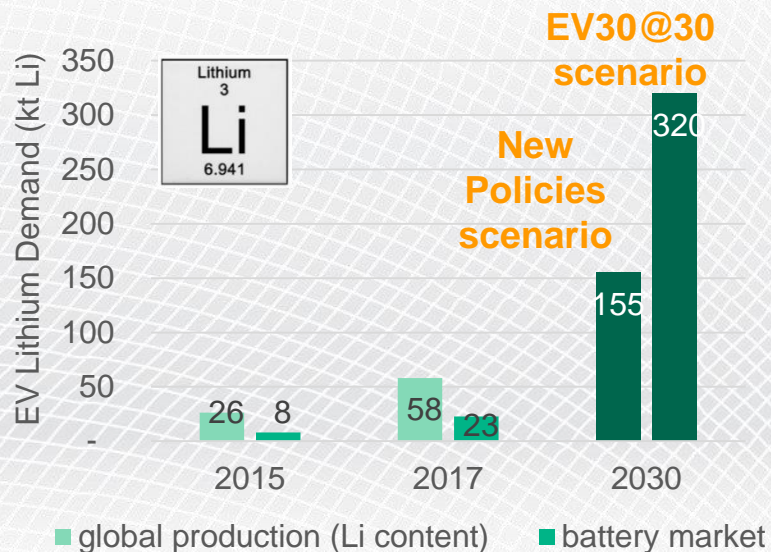
Battery technology evolution



Battery technology evolution is very dynamic and it will influence raw material requirements.

Demand for battery raw materials

Cobalt; Lithium

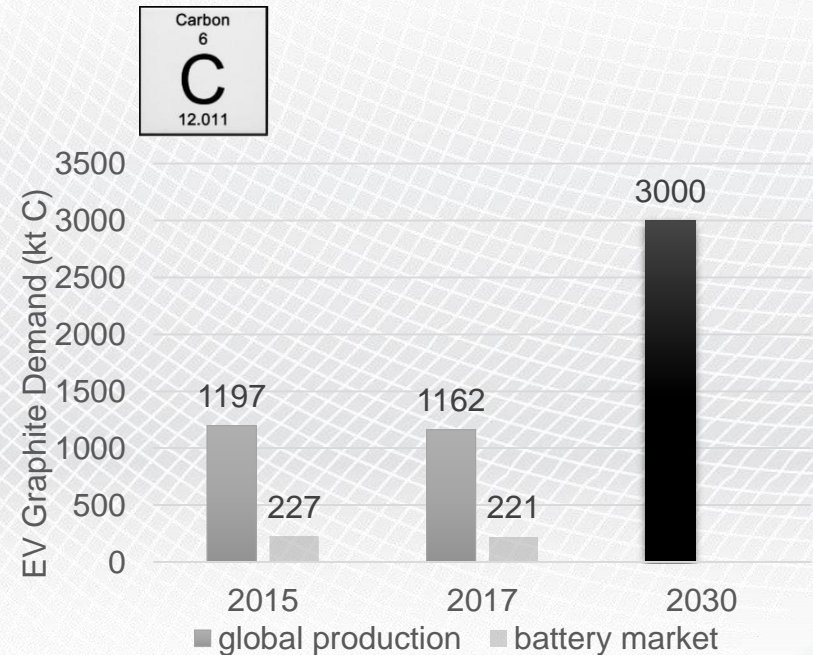
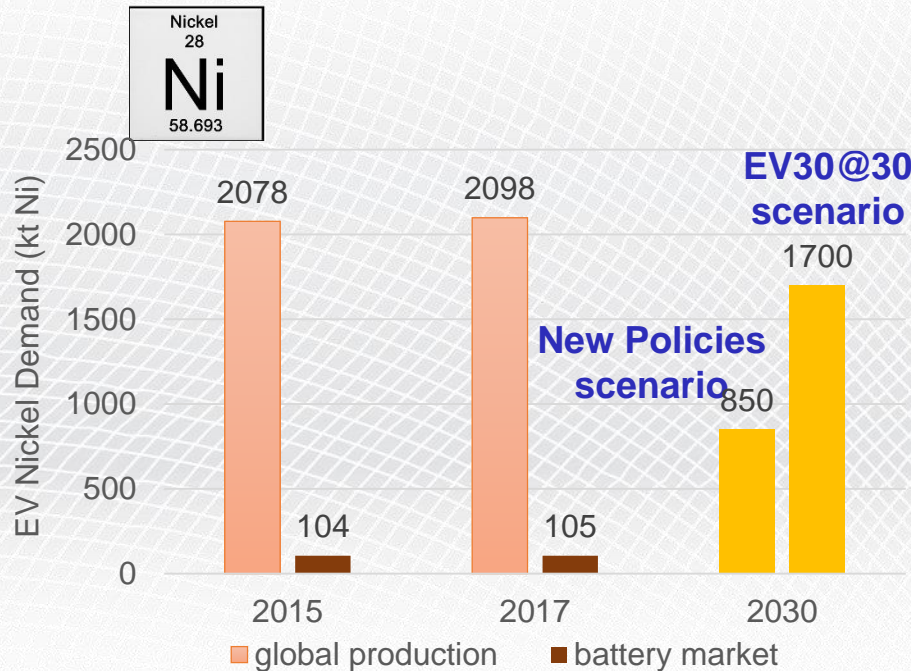


- CAGR over the past 10 yrs 11%
- A requirement for a 5-fold increase in global lithium production by 2030 to satisfy the EV global demand

- CAGR over the past 10 yrs 5%
- A requirement for a 3-fold increase in global cobalt production by 2030 to satisfy the EV global demand

Demand for battery raw materials

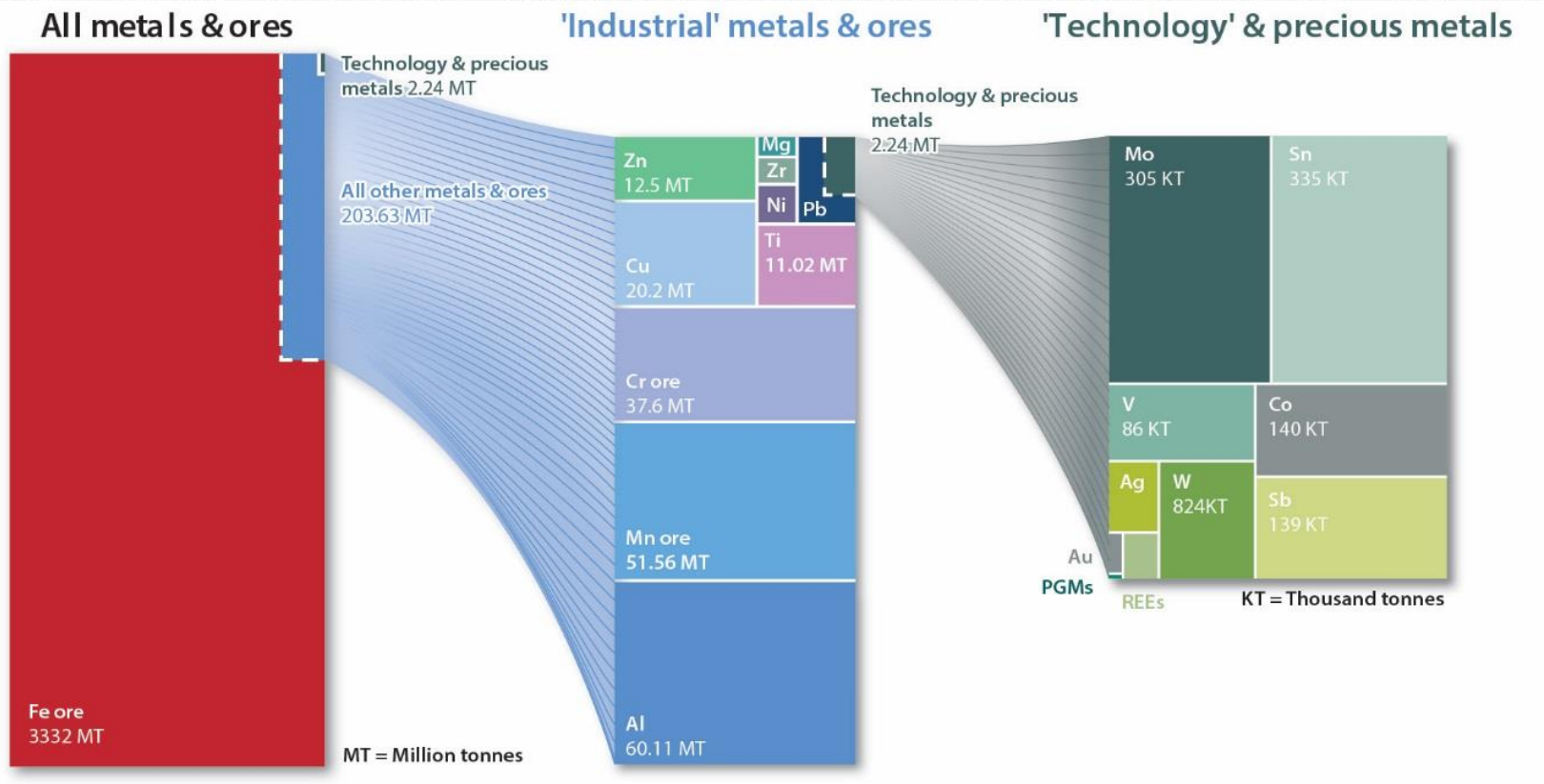
Nickel and graphite



- Demand for high purity nickel sulfate (class I) requires additional capacity and suitable feedstock material.
- Current global mine production is primarily for ferronickel

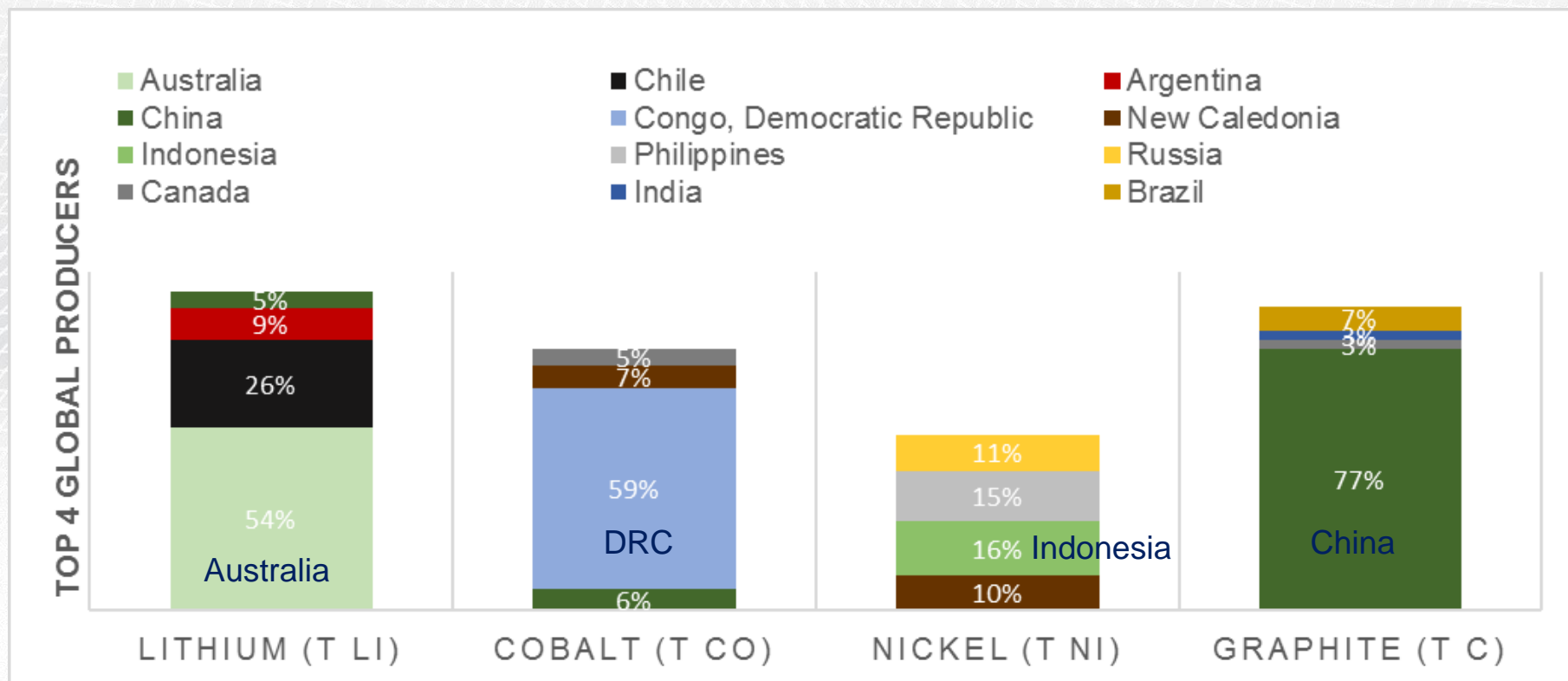
- Global graphite production should double by 2030 to satisfy EV global demand
- Batteries are not the largest market for graphite.

Global metal production



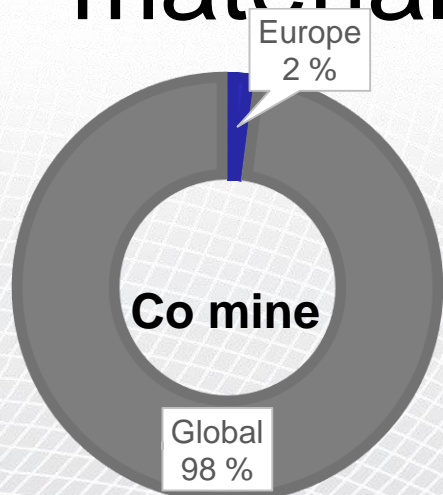
[2017 Data from: BGS World Mineral Statistics Database]

Battery raw materials – global supply

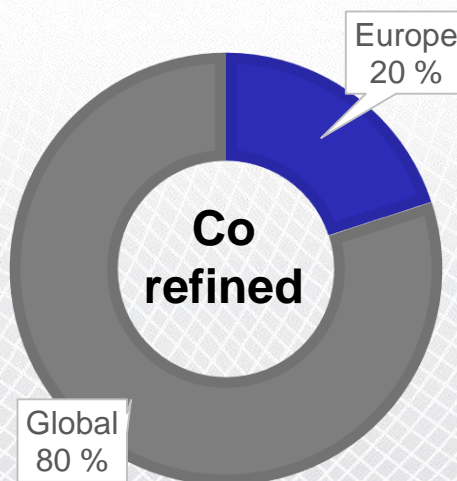


[2017 Data from: BGS World Mineral Statistics Database]

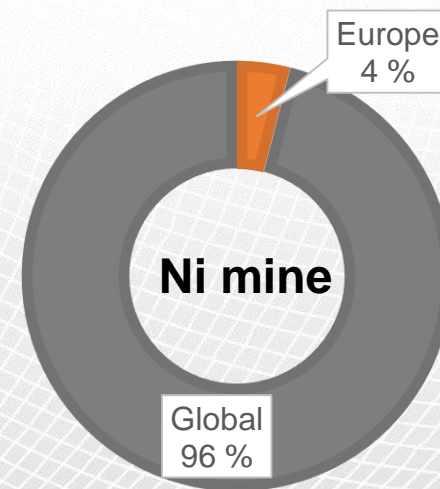
European battery raw materials



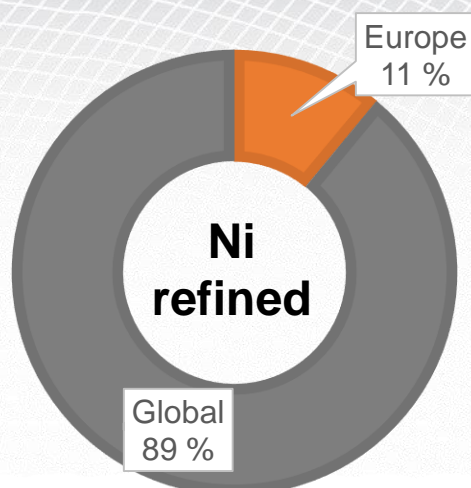
[Finland]



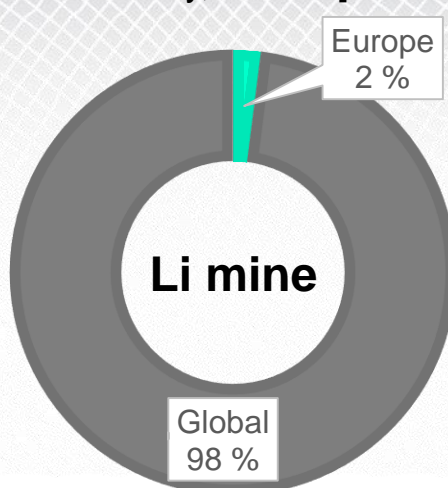
[Finland, Belgium, Norway, France]



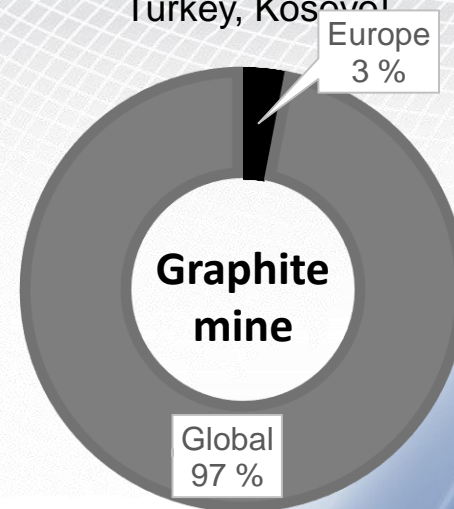
[Finland, Greece, Turkey, Kosovo]



[Finland, Norway, UK, Greece]



[Portugal]



[Austria, Norway, Germany]

Automotive: decisions to 2030

200 Average CO₂ emission levels for new passenger cars in the EU with current and proposed regulatory target values

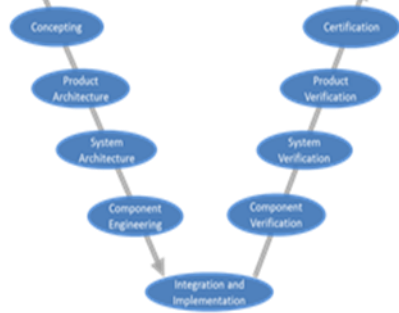
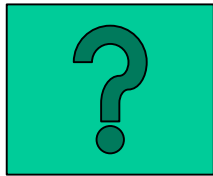
Raw materials production

Design, Development

Production

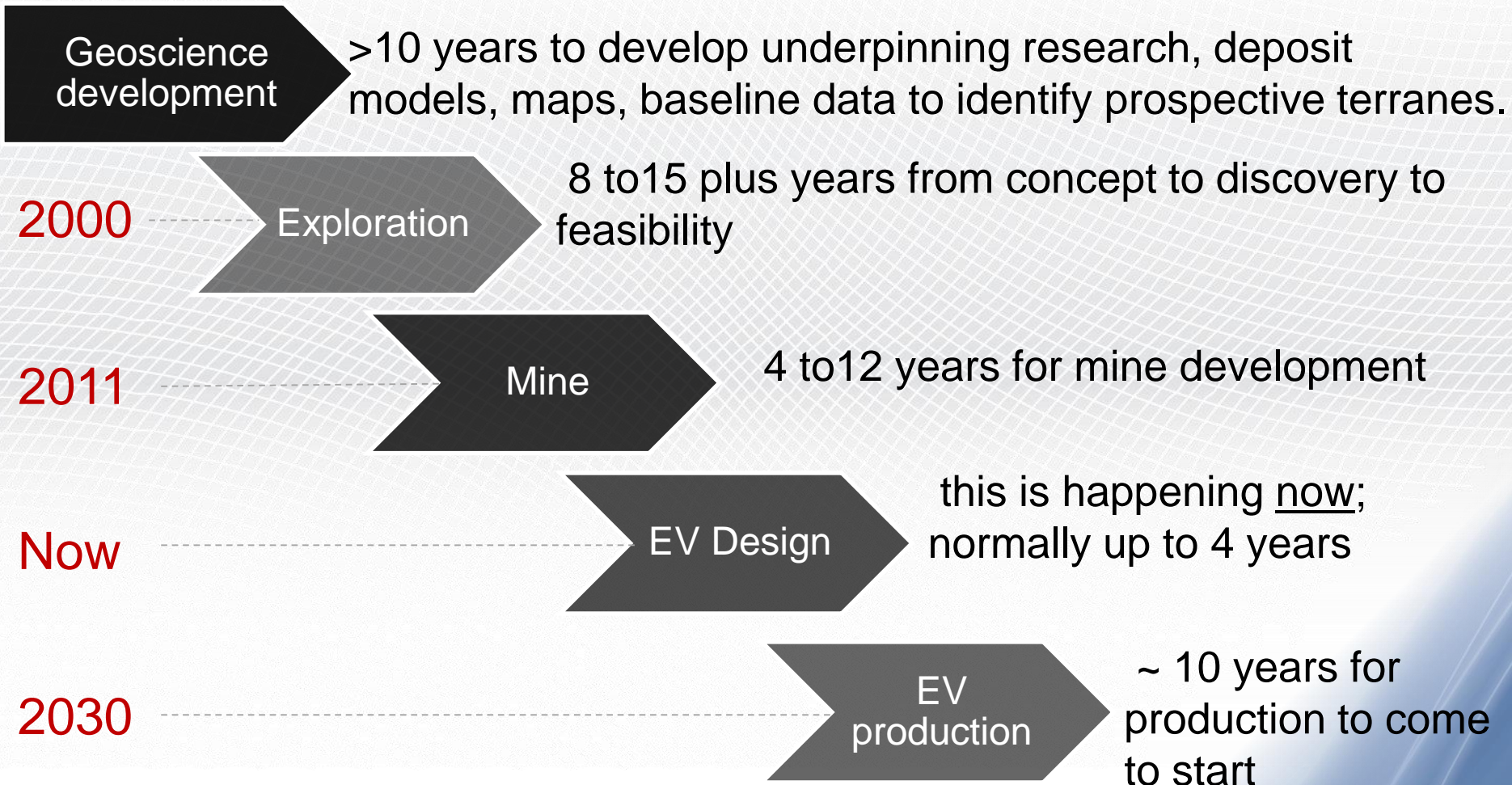
42 Months

10 Years



Automotive: decisions to 2030

the Full picture



Final remarks

- Upscaling battery production is challenging due to the short time frame available to develop new mines, plants and production lines.
- Big demand for battery raw materials has not yet reached the market.
- Geoscience will need to support this transition with better fundamental geological data and research. Better exploration and tools to assist the identification of new deposits.
- Supply chains must converge and coordinate actions or otherwise we will fail.
- Concerns over supply should be assessed following a holistic analysis of the supply chain. Monitoring of the physical economy.

The goal is the sustainable and responsible supply of battery raw materials